



British Horological Institute

Syllabus:-

Certificate in Clock and Watch Servicing

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Introduction:-

Aims:-

The Certificate in Clock and Watch Servicing is designed to fulfil the following aims:-

- to provide a national qualification, with accredited national standards, recognisable to centres, students and employers within the horological industry
- preparation for employment as a technician servicing clocks and / or quartz watches
- progression to a two year specialist course in Clock or Watch Repair and Restoration
- progression to Level 3 NVQ in Instrument Servicing

Examination design and structure:-

The award, Certificate in Clock and Watch Servicing, is a “Vocationally Related” qualification at Level 2, Intermediate Level, within the National Framework. It was developed by the British Horological Institute to provide a qualification, which meets the needs of the horological industry; the development process included consultation with the training facilities present in the United Kingdom. Candidates who gain the award will have to satisfy the British Horological Institute Examinations Board in two mandatory units and one optional unit; each unit is separately accredited and certificated. No time limit is placed on completion of the Certificate in Clock and Watch Servicing.

Mandatory units:-

Unit 1: Technician Grade: Theory of Clock and Watch Servicing

Unit 2: Technician Grade: Basic Practical Workshop Processes

Optional Units, candidates select one of the following:-

Unit 3: Technician Grade: Technical Drawing

Unit 4: Technician Grade Practical Clock / Watch Servicing

Units 1, 2, & 3 are assessed externally by examination; Unit 4 is assessed internally by a qualified professional member of the British Horological Institute (MBHI, FBHI). The Examinations Board is responsible for the external assessment and verifies and monitors the arrangements for internal assessment.

Information providing an outline of the content, details of the syllabus, learning outcomes and assessment procedure is given within the section allocated for each unit.

The following grades of pass are awarded:-

Mandatory units:-

Unit 1: Technician Grade: Theory of Clock and Watch Servicing
Pass - 40% Pass with Merit - 66%

Unit 2: Technician Grade: Basic Practical Workshop Processes
Pass - 40% Pass with Merit - 66%

Optional Units:-

Unit 3: Technician Grade: Technical Drawing
Pass - 40% Pass with Merit - 66%

Unit 4: Technician Grade Practical Clock / Watch Servicing
Pass - awarded if the candidate has provided a completed “Record of Repairs” demonstrating competence throughout the breadth of skills required by the awarding body.

Candidates receive a certificate showing each unit successfully completed. There are two levels of pass for each unit. (‘Pass with Merit’ (66%) and ‘Pass’ (40%))

To gain the award a candidate will require:-

Pass:- A ‘Pass’ in the two mandatory units together with a ‘Pass’ in one optional unit.

Pass with Merit:- A ‘Pass with Merit’ in both of the two mandatory units together with a ‘Pass’ in one optional unit

Unit 1: Technician Grade, Theory of Clock and Watch Servicing

Outline:-

This unit provides essential underpinning knowledge for the practical units, including construction, functioning and servicing of basic timepieces and striking clocks, quartz and mechanical watches and the technology of basic workshop processes.

Syllabus:-

Clocks:-

- Clock identification:- types of clocks; terminology e.g. carriage, lantern, longcase, Vienna regulator, bracket
- Basic parts of a clock:- frame; motive force; winding mechanism; train; motion work; hand setting mechanism; escapement; oscillator
- Analysis of a simple clock movement:- barrel assembly; pillars; plates; bridges and cocks; ratchet; click; click spring; cannon pinion; minute wheel and pinion; hour wheel; construction of train; wheels and pinions; pallet and crutch assembly
- The pendulum and timekeeping:- definition of the pendulum; isochronism; pendulum formulae and calculations; pendulum suspensions; beat setting devices
- The motive force:- weight driven clocks; portable timekeepers; mainspring proportions:- length, width, height; barrel and arbor; going barrel; fusee; mainspring winder; defects in mainsprings; detachable barrel; mainspring hookings
- Trains:- types of trains:- going train, striking train, motion work, single stage, two stage; diagrammatic clock trains; train counts
- Pivots:- types; proportions; side – shake; end-shake, defects; broaching; bushing
- Striking clocks:- rack and locking plate strike mechanisms; assembling striking clocks
- Diagnosis and correction of defects:- e.g. cleaning; wear; damage; bushing

Watches – general:-

- Modern wrist watch cases:- snap on back and bezel, screw on back and bezel, two piece case, three piece case; water resistant; sizes; case materials, e.g. gold, gold plated stainless steel; opening watch cases; straps; bands; bracelets
- Dials and hands
- Watch movement identification and exchange; part identification
- Calendar work:- simple calendar work
- Water resistance:- testing methods; terminology for water resistance

Watches – mechanical:-

- Analysis of a simple watch mechanism:- pillar plate, barrel and train bars, cocks; the watch train; keyless work; barrel assembly; motion work; friction drive to cannon pinion; Roskopf motion work; centre seconds train
- Mainsprings:- spring hookings; snailed barrel arbor; recoiling click; mainspring proportions:- length, width, height; mainspring winder, defects in mainsprings
- Pivots:- types; proportions; jewels; shockproof settings; defects
- Use of the rate recorder:- regulate; diagnose faults; beat adjustment
- Diagnosis and correction of defects:- e.g. wear; damage; interchangeable parts; inspection; servicing

Watches – quartz:-

- Analysis of a simple quartz watch mechanism:- the watch train, motion work; friction drive to the cannon pinion; handsetting
- Analysis of a quartz watch circuit:- battery; switch; integrated circuit; coil; stepping motor; quartz oscillator; trimmer; inhibition
- Electrical units:- amp; volt; ohm; multiples and sub multiples of basic units
- Basic electricity and magnetism as applied to quartz watches
- Watch batteries:- different types of battery; battery fitting; capacitors; end of life indication
- Piezo-electric effect, principle of operation of a stepping motor

Watches – quartz, continued:-

- Tests for quartz watches:- consumption; lower working voltage limit; grounding switch; resistance; rate; diagnose faults; rate adjustment
- Principle of quartz liquid crystal display
- Quartz movement:- inspection, servicing

Escapements:-

- The escapement:- functions of the escapement; types of escapement e.g. verge, recoil, dead beat, cylinder, club tooth, pin lever, ratchet tooth, balance and spring
- Recoil anchor escapement:- general description; action of the anchor escapement: impulse, drop, recoil, supplementary arc and angle, impulse angle of the pallets; advantages of the recoil escapement; diagnose faults
- Club tooth lever escapement:- general description; action of the club toothed lever escapement: impulse, drop, draw; safety action: guard pin, roller, horns
- Pin pallet escapement:- general description; action of the pin pallet escapement: impulse, drop, draw; safety action: guard pin, roller, horns

Workshop Processes:-

- Marking out tools:- use and construction of scribe, centre punch, dividers, calipers, rule
- Hand tools:- types and care of: files; broaches; cutting; smoothing; dies; taps; screw plate; abrasives
- Drills and drilling:- hand drill; drilling machine; types of drills, twist drills; countersinks
- Measuring instruments:- micrometer; vernier caliper; digital electronic caliper
- Materials:- iron; steel; brass; hardening and tempering; work hardening; bluing; abrasives; polishing materials; cleaning materials; solder
- Centre lathe:- use, parts and construction: headstock, tailstock, bed, carriage, compound slide; cutting speeds; cutting tools; work holding techniques: three jaw chuck, four jaw chuck, faceplate, collets, use of centres, carrier and driving plate, drilling in the lathe; safety and maintenance
- Watchmaker's lathe:- use, parts and construction: headstock, bed, tailstock, T-rest; the graver, use and maintenance; work holding techniques: collets, step chucks, wax chucks, carrier chuck, mandrel, jacot drum, lantern runner; drilling using a watchmaker's lathe; filing rest, compound slide; safety and maintenance

Learning Outcomes:-

The successful candidate will be able to:-

- identify different types of clock and watch movements
- understand the construction and operation of single train and striking clocks
- understand the construction and operation of basic mechanical and quartz analogue watches
- understand the construction and operation of basic quartz LCD watches
- calculate the train of a clock and pendulum length
- understand the principles of testing for water resistance and the measures adopted by manufacturers to exclude water from watch movements
- diagnose and know how to correct basic defects in clocks and watches
- understand the construction and operation of basic tools and machines for making replacement clock components
- know the composition and properties of materials used to make replacement clock components

Assessment procedure:-

This unit is externally assessed; a 2½ hour examination paper set by the Examinations Board of the British Horological Institute assesses the candidate's knowledge and understanding of the Theory of Clock and Watch Servicing. Candidates are required to answer one question from each section of the examination paper - clocks; watches; escapements; workshop processes and also twenty short questions sampling the syllabus.

The scripts are assessed by Examiners appointed by the Examination's Board on the basis of the accuracy and depth of the content; two grades of Pass are awarded Pass (40%) and Pass with Merit (66%)

Unit 2: Technician Grade, Basic Practical Workshop Processes

Outline:-

The practical use of tools and machinery to measure, produce and modify simple clock components made from brass and steel.

Syllabus:-

- Health and safety:- personal, fellow workers, visitors
- Mark out, from a drawing, using rule, scribe, dividers, centre punch, use of master edge
- Use hacksaw, piercing saw and files to produce flat / curved, square surfaces to required dimensions
- Drill holes using a drilling machine, countersinking
- Use a lathe (watchmaker's and centre lathe) including use of collets and chucks; centres; compound slide, with lathe cutting tools and graver for turning cylindrical, flat and spherical surfaces; sharpen lathe tools and graver; drilling including "catching" a centre; turning and burnishing pivots; filing flats
- Make screws:- cutting threads, internal and external; cutting screw slots; hardening and tempering screws, polishing screw threads, bluing
- Produce square holes:- punching; drilling and filing
- Fasten components:- using soft and hard soldering techniques, riveting, screws, adhesives
- Produce grained and polished finish to flat and turned surfaces on brass and steel
- Form simple bends to brass and steel components
- Heat treatment of steel and brass:- hardening, tempering, annealing, bluing

Learning outcomes:-

The successful candidate will be able to:-

- read drawings, measure and mark out components accurately
- make and modify steel and brass components for clocks to within a tolerance of $\pm 0.1\text{mm}$ using basic hand tools, a centre lathe and a watchmakers lathe, including the cutting of threads, hard and soft soldering, riveting, heat treatment and finishing to provide polished, grained and blued surfaces.

Assessment procedure:-

This unit is externally assessed; the British Horological Institute provides each candidate with a dimensioned drawing giving full details of an assembly of small clock components or tool; the period of two weeks is allocated for candidates to produce the component.

A declaration signed by the candidate and, where appropriate, the college tutor provides confirmation that the piece is the candidate's own work; 10% of candidates will be contacted by an Examiner to verify the declaration.

Examiners appointed by the Examinations Board assess the practical test pieces by considering accuracy, quality of workmanship and finish. Two grades of pass are awarded, Pass (40%) and Pass with the Merit (66%).

Unit 3: Technician Grade, Technical Drawing

Outline:-

This unit includes the use of orthographic, isometric and oblique projection to draw components for clocks.

Syllabus:-

- Use tools for drawing:- e.g. pencils; drawing board; T-square; set squares; compasses; dividers; rule; paper and/or computer, CAD program, printer
- Layout drawings:- title block; scales lettering and numerals
- Produce drawings in orthographic projection according to “Engineering Drawing Practice for Schools and Colleges” (PP7308):-
 1. use different types of line e.g. outlines, dimension lines, limits of partial views, hidden detail, centre lines, cutting planes; coinciding lines
 2. produce sections and sectional views:- cutting planes; hatching (separated areas, adjacent parts, hatching adjacent parts at the same angle)
 3. use conventions e.g. symbols and abbreviations; simplified representations of intersections; plane faces on cylindrical parts; knurling; screw threads including assembled threaded parts; gears
 4. dimension drawings:- general principles; projection lines; dimension lines, arrowheads, arrangement of dimensions; dimensioning interrupted features; methods of dimensioning common features
 5. produce title block to contain title, scale, units, type of projection
- Use different types of projection:- first angle orthographic projection; third angle orthographic projection; projection symbols; isometric projection; oblique projection
- Produce constructions - epicycloid; hypocycloid; involute

Learning Outcomes:-

The successful candidate will be able to:-

- read dimensioned drawings
- produce scaled drawings of clock components and assemblies according to procedures detailed in PP 7308
- produce pictorial views of clock components in isometric and oblique projection
- draw various construction including loci which form the basis of gear tooth forms (cycloid, epicycloid, hypocycloid)

Assessment Procedure:-

This unit is externally assessed; the Examinations Board of the British Horological Institute sets a 3 hour drawing examination. Candidates are provided with a pictorial view of an assembly of clock components; they are required to draw to scale, in orthographic projection, various elevations with / without a sectional view. The drawing is to be titled and dimensioned. Drawings for the examination may be produced manually, using pencil, paper and drawing instruments or using CAD. If CAD is chosen the candidate must submit a printed copy of the drawing together with details of the program used and a copy saved on disc. During the examination the candidate is only permitted to open the CAD program and is not allowed to access information from another computer via a network or shared server.

Examiners appointed by the Examinations Board assess the technical accuracy and completeness of the candidate's drawing. A candidate gaining over 40% will be awarded a "Pass", if gaining 66%, or higher a "Pass with Merit" is awarded. A Pass (40%) is required to demonstrate competence.

Unit 4: Technician Grade, Practical Clock / Watch Servicing

Outline:-

The practical servicing of basic clocks / watches.

Syllabus:-

Clocks:-

- Clock identification:- identify by type and calibre number
- Customer care:- record customer details; give accurate estimates for repairs; record accurate details of clocks and work completed
- Cleaning fluids:- select, use safely and dispose of with respect to the environment
- Single train movement with going barrel; dismantle, clean, reassemble lubricate and adjust
- Mass produced rack strike movement:- dismantle, clean, reassemble, lubricate and adjust
- Mass produced locking plate strike movement:- dismantle, clean, reassemble, lubricate and adjust
- Fusee:- safely remove the power and set up a fusee movement with the appropriate pre-load
- Mainsprings, barrel and loop end mainsprings (springs not enclosed in barrels):- safely remove the power, dismantle and reassemble a movement with barrel and a movement with a loop end mainspring
- Platform escapement:- remove dismantle, clean, oil replace and adjust
- Worn pivot holes:- use cutting and smoothing broaches; select and fit a variety of bushes; return wheels to upright
- Worn pivots:- restore as appropriate by turning, stoning and burnishing, use of pivot file
- Beat:- check for “beat”; adjust
- Timing machine:- use to regulate a clock for rate, adjust beat and identify defects

Mechanical Watches:-

- Watch identification:- identify by calibre and calibre number
- Customer care:- record customer details; give accurate estimates for repairs; record accurate details of watches and work completed
- Cleaning fluids:- select, use safely and dispose of with respect to the environment
- Lady's and gents wrist watches and pocket watches, manual wind , pin lever and jewelled lever, calendar:- dismantle, clean, reassemble, lubricate and adjust
- Timing machine:- use to regulate a watch, adjust beat, and identify faults
- Jewels and pivots:- identify worn and damaged jewels, pivot holes and pivots
- Mainsprings:- remove, replace, identify and select
- Watch glasses:- select and fit a variety of watch glasses suitable for mechanical watches
- Straps and bracelets:- fit a variety of straps and bracelets, remove and replace different types of spring bars (e.g. simple, thin, curved, flanged, clasp and bracelet spring bars); remove a variety of links from bracelets
- Button and stem:- remove, replace, select and fit new stems and water resistant, dust proof and ordinary buttons
- Pushers:- remove and replace a variety of pushers
- Calendar work:-dismantle, reassemble and lubricate gradual and instantaneous calendar work
- Water resistance:- renew a variety of water resistant seals to buttons, pushers, glasses and case back as appropriate; execute water resistance tests by wet and dry methods to verify to manufacturers specification but excluding diver's watches

Quartz Watches:-

- Watch identification:- identify by calibre and calibre number
- Customer care:- record customer details; give accurate estimates for repairs; record accurate details of watches and work completed
- Watch glasses:- select and fit a variety of watch glasses suitable for quartz watches

Quartz watches, continued:-

- Straps and bracelets:- fit a variety of straps and bracelets, remove and replace different types of spring bars (e.g. simple, thin, curved, flanged, clasp and bracelet spring bars); remove a variety of links from bracelets
- Button and stem:- remove, replace, select and fit new stems and water resistant, dust proof and ordinary buttons
- Pushers:- remove and replace a variety of pushers
- Calendar work:- dismantle, reassemble and lubricate gradual calendar work
- Water resistance:- renew a variety of water resistant seals to buttons, pushers, glasses and case back as appropriate; execute water resistance tests to verify manufacturers specification but excluding diver's watches
- Multimeter:- make appropriate electrical tests including: consumption, lower working voltage limit, grounding switch and resistance, test watch batteries under appropriate load
- Watch batteries:- remove, select and fit a variety of suitable replacement batteries
- Cleaning fluids:- select, use safely and dispose of with respect to the environment
- Lady's and Gents quartz analogue watches- dismantle, clean, reassemble, lubricate and test
- Liquid crystal display watches:- dismantle, clean, reassemble and test

Learning Outcomes:-

The successful candidate will be able to:-

- dismantle, clean, reassemble, lubricate and adjust basic clocks / watches
- conduct appropriate tests on clocks / watches to determine conformity with standards of accuracy and operation
- diagnose defects in basic clocks / watches
- correct simple faults in basic clocks / watches

The assessment strategy:-

This unit requires the candidate to produce a “Record of Repairs”. The “Record of Repairs” gives the Examiner basic information about a number of clock / watch repairs that the candidate has completed. The Institute provides a form, the “List of Contents”, to guide the candidate. This form shows the number of repairs which are required and also gives a number of “Repair Processes” such, as refinishing and burnishing clock pivots. The candidate uses the “List of Contents” to itemise the repairs that are being included. Separate forms, “Clock Form”, “Quartz Watch Form” and “Mechanical Watch Form” enable the candidate to record details about each item that has been repaired including the nature of the work undertaken. Each repair has to be checked by a professional member of the Institute (MBHI / FBHI) to ensure that the work has been completed to a good standard.

There is the opportunity to select from the following Record of Repairs:-

1. Clocks - The candidate has to complete six clock repairs together with a number of basic clock repair processes.
2. Watches - The candidate has to complete ten watch repairs together with a number of basic watch repair processes. At least five of these watches must be quartz watches and five must be cased as distinct from movements. There are no particular requirements regarding the size of the calibres.
3. Clocks and Watches – The candidate has to complete four clock repairs and five quartz watch repairs together with a number of basic clock and quartz watch repair processes. The quartz watches must be cased rather than movements.

In each instance the “List of Contents” summarises the overall requirements and enables the candidate to record all of the various items that have been repaired. A separate form for each repair, the “Clock Form”, “Mechanical Watch Form” or “Quartz Watch Form”, is used to describe the work completed.

The forms for documentation and the Assessor Guidance Notes are available from the Examinations Secretary at Upton Hall.

Assessment Procedure:-

This unit is internally assessed by qualified members of the British Horological Institute (MBHI / FBHI) as explained above. Candidates are required to produce a “Record of Repairs” describing the work they have undertaken when servicing clocks / watches.

The Record of Repairs is checked by the Senior Examiner to ensure that the required number of items has been serviced and the fundamental servicing processes have been included, every item and process must have been approved to ensure that the servicing has been completed to a high standard. A candidate who has met all the requirements will achieve a Pass.